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## RSNA Press Release

### Imaging Provides Clues to Iceman's Life and Death

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OAK BROOK, Ill. - A man entombed in ice for over 5,000 years had suffered from arthritis and other modern complaints before succumbing to an arrow wound, according to a study appearing in the March issue of the journal *Radiology*. Modern imaging techniques allowed researchers to investigate the 5,300-year-old "Iceman" without damaging the archeological treasure.

In 1991, hikers discovered the Iceman at a remote site in the Tyrolean Alps. A team of scientists and radiologists from Austria, Italy and the United States imaged the Iceman's bones and tissues and interpreted the images. The anatomic features of the Iceman were thoroughly documented with conventional radiographic (x-ray), portable computed radiographic, and conventional and spiral computed tomographic (CT) images obtained between September 1991 and June 2001.

"The research confirmed that 5,000 years in human evolutionary terms is not much more than a 'blink-of-an-eye' because the Iceman's anatomy and evidence of medical conditions are substantially similar to those of modern humans," said William A. Murphy Jr., M.D., lead author of the international study and professor of radiology at the University of Texas M. D. Anderson Cancer Center in Houston.

The images showed evidence of degenerative arthritis, frostbite, vascular calcification and adaptation to cultural and geographic influences.

The researchers believe that the Iceman was well preserved because the combination of direct, hot alpine sun and cold, dry air mummified the prehistoric corpse. Glacier formation protected him for five millennia. The images reflected tissue changes caused by natural dehydration due to the environment, which left the skin, muscle and organs severely shrunken.

Because of mummification, the investigators could not identify the Iceman's arteries, but calcifications were detected where the arteries should have been. "These calcifications may present a surprising amount of evidence for arteriosclerotic cardiovascular disease, particularly if we share the perspective that this condition is a modern affliction facilitated by lifestyle, diet and tobacco use," the research team reported.

The Iceman may have had degenerative disk disease in his neck, as well as painful arthritis of the right side of the pelvis and hip, conditions commonly seen today. He also had arthritis in his left little toe attributed to frostbite.

Radiological images documented several types of injuries including healed rib fractures and an arrowhead lodged between the left shoulder and the nearby rib cage, the presumed cause of death. The arrow in his back appeared to have severed a blood vessel and may have led to the death of the Iceman when he was between 40 and 50 years old. The investigators theorized that he died from a combination of bleeding and freezing.

"The imaging research provided a means for nondestructive investigation. Dramatic information was obtained with no damage to the body, and application of modern medical imaging promoted preservation," said Dr. Murphy.

The international team of investigators took advantage of new imaging technologies that were emerging in 1991. "Spiral CT allowed us to scan the Iceman quickly to prevent him from thawing," said Wolfgang Recheis, Ph.D., from the University of Innsbruck in Austria. Dr. Recheis noted that the first trials of 3-D reconstruction from medical image data sets were done with the Iceman data and credited the early medical use of the rapid prototyping technology stereolithography, which uses CT image data to build 3-D models a layer at a time. "Worldwide, the first skull built with this technique was the skull of the Iceman," Dr. Recheis said. As the work continued over the years, new technologies were incorporated into the investigation.

"Imaging the Iceman is an excellent example of international cooperation, wherein physicians and scientists freely cooperated and shared their talents. The combination of various points of view yielded improved scientific results," Dr. Murphy said. "In the future, standard archeological practice will use imaging to simultaneously investigate and preserve ancient artifacts. Imaging also will be used to guide and control acquisition of minute tissue samples thus minimizing damage," he predicted.

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*Radiology* is a monthly scientific journal devoted to clinical radiology and allied sciences. The journal is edited by Anthony V. Proto, M.D., School of Medicine, Virginia Commonwealth University, Richmond, Virginia. *Radiology* is owned and published by the Radiological Society of North America Inc. (<http://radiology.rsna.org>)

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"The Iceman: Discovery and Imaging." Collaborating with Dr. Murphy and Dr. Recheis on this study were Dieter zur Nedden, M.D., from the University of Innsbruck in Austria; Paul Gostner, M.D., from the Regional General Hospital in Bolzano, Italy; Rudolf Knapp, M.D., from the Kufstein Hospital in Kufstein, Austria; and Horst Seidler, Ph.D. from the University of Vienna in Austria.